Light and Lighting

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The I.E.S. Session

OCTOBER brings the opening of a new session for many scientific, technical and cultural societies, whose members—refreshed by the Summer break, we hope—will now be looking forward to new papers and discussions upon the subjects which excite their interest. The programme for the new Session of the Illuminating Engineering Society offers a large number of papers to be given in London and in the Society's provincial centres, and the papers certainly do not lack variety in subject-matter. A few titles will give some idea of the programme range: there are papers on "Light from Space," "Light and Crime," "Outdoor Decorative Lighting," "Dark Adaptation," "Hospital Lighting," "Illumination and Illusion," "Fine Detail," "Lighting in the Home," "Lighting for High Speed Photography and Cinematography," and "Modern Airport Lighting." Some of these titles are intriguing but this random selection omits numerous papers which will doubtless prove most interesting and informative. The I.E.S. goes from strength to strength in membership, and from its programme for the current Session it is evident that it endeavours to serve the interests of all members.

Notes and News

I.E.S. President 1951-52

The new session of the I.E.S. opens on October 9 when the present President, Mr. L. J. Davies, retires and Mr. J. G. Holmes takes office for the following year.

Mr. Holmes has been most actively connected with the Society for many years and is well qualified for the office of President. He is a glass and lighting technologist and became interested in both subjects during his student days when he took optics as his subject for research at London University. He was with Chance Bros. at Smethwick for a number of years and was a senior member of their laboratory staff when he moved to London at the end of the war to join Holophane, Ltd. Mr. Holmes has published many scientific and technical papers including several in the I.E.S. Transactions and he was awarded the Leon Gastor Memorial Premium in 1941. He is chairman of the N.I.C. sub-committee on the colours of light signals and is a prominent member of a number of technical groups and committees. Other activities are indicated by his recent chairmanship of the Physical Society Colour Group and of the London Section of the Society of Glass Technology. Whilst he was at Birmingham Mr. Holmes served as chairman of the Birmingham Centre of the I.E.S. (incidentally he is the first Centre Chairman to become President) and this, together with his membership of the Council over a number of years and his recent three year period of office as Hon. Treasurer, has given him a wide knowledge of the Society's activities both in London and in the Centres and Groups.

Mr. J. G. HOLMES

We would congratulate Mr. Holmes on his appointment as President of the I.E.S. and wish him every success during his term of office.

The meeting on October 9 when Mr. Holmes will give his Presidential address will be held at the Royal Institution, Albemarle-street, W.1, at 6 p.m.

Discomfort Glare

The usefulness of international conferences cannot be measured only by the success of the formal sessions. The informal and social contacts have their special place, as these notes hinted last month. We also hear of another kind of discussion which may be at least as far-reaching in its effects, the informal but highly technical discussion of workers in specialised fields who hammer out their experimental problems in a way which is not possible in an open meeting. Such a discussion happened during the C.I.E. meeting at Stockholm on the work on glare discomfort.

Dr. Ward Harrison's article in the December, 1950, issue of *Light and Lighting* drew attention to the various researches which had covered similar fields in the Netherlands, the United

Kingdom and the U.S.A. Dr. Harrison suggested that there were many problems on the question of glare discomfort which had not yet been satisfactorily solved. The C.I.E. meeting seemed to offer an ideal opportunity to bring together the workers on the glare problem.

In general the various studies show close agreement. Glare-discomfort is clearly a function both of the source brightness and of its apparent area (and hence of its intensity), and it is certainly governed by the adaptation level as well. It is influenced by the angular separation of the sources from the point of regard, the farther away the less the discomfort.

So far so good. The various investigators have found very similar relationship between the same factors. In some cases the results published by Petherbridge and Hopkinson lie so close to those of Guth that the same regression line applies to each set of data. This is remarkable when it is considered that the experimental points are determined solely as the result of the subjects' mental estimations. In other cases the difference between the results is no greater than between "just uncomfortable" and "just intolerable." Consequently the various investigations could be used as a basis for a Code of Practice should such be desired.

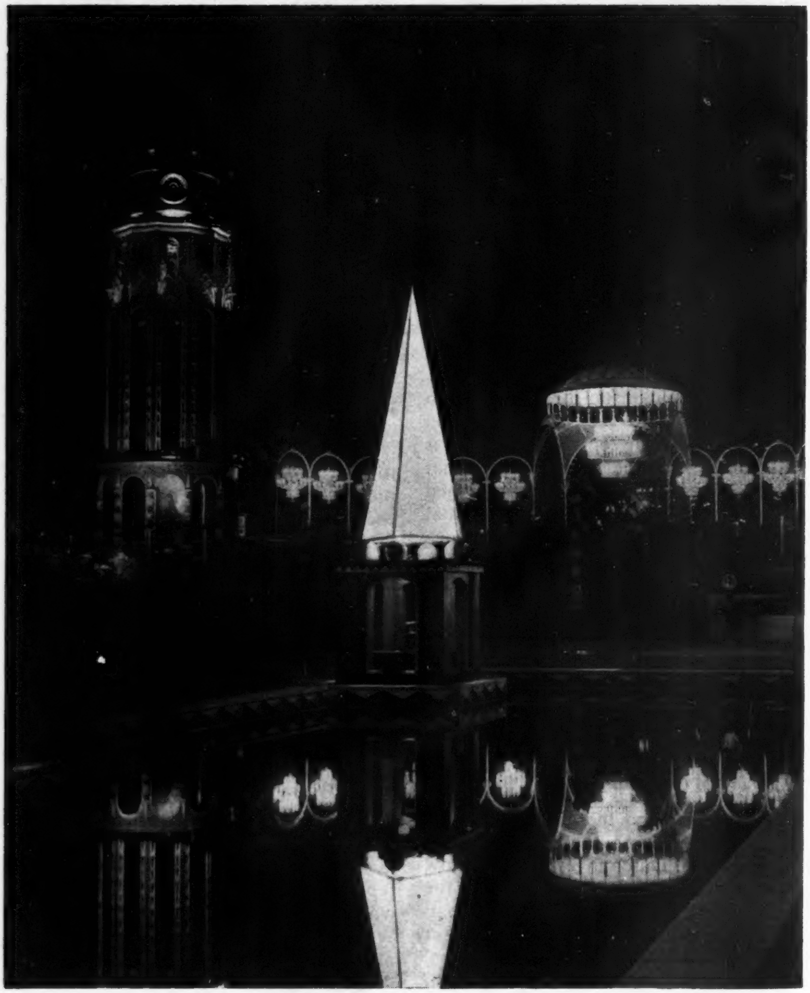
There remain differences in the results which, though not of great significance to the practising engineer, cause the investigators themselves some concern. In particular the effect of the change of area of a source on the glare-discomfort needs further study. In this respect the British and the Dutch investigations show closer agreement than do either with the U.S.A. work. The former suggest that, if sources are added to the environment which produce a truly proportional increase in the brightness of the environment, the glare discomfort will not increase, whereas the American work suggests that it will.

It was agreed to put in hand in all the laboratories a joint programme to cross-check this and some other points. The Americans have used a technique which employs the "momentary exposure" of the glare sources (corresponding to the effect produced when one looks up from one's work) whereas the British and Dutch have used "continuous exposure" of the sources. They are now each going to try both methods, to see if the difference in the results can be explained on these lines.

The results of the cross-checks may be a little while in coming out, but they should help to resolve one of the problems of brightness engineering, in which much interest is now being shown. Absence of discomfort is not the same thing as comfort, however, and we look forward to the next stage in these studies, which will tell us how to produce effects of positive comfort and satisfaction in our lighting designs.

The Artistic Approach

A number of our spies who have been to the Continent recently have commented on their return on the imaginative use which is made of fluorescent lighting in some of the countries they have visited. The impression seems to be gained that whilst we in this country are content with the fact that we produced the lamps in the first place but really couldn't care less how they are used, our friends on the Continent are concerned only with what they can do with the lamps. Things might not be quite as bad as that but it would certainly seem that in this country we could make more use of the "lighting artist" than we do at the moment. The artistic approach is not a thing which can easily be discussed at international meetings such as the one reported in our last issue but is a thing which needs to be studied at first hand. We would like to see some encouragement given to the younger members of the lighting industry to travel abroad to study such matters. It is a regular thing for architectural students to make quite extensive (and not necessarily expensive) tours of Europe to broaden their outlook but the horizon of the student of illuminating engineering is far too often limited by a fittings catalogue.



Lighting at the Festival Pleasure Gardens. View of the entrance cupola to the main vista.

Lighting Aims and Techniques

In this article, the third in the series on lighting developments in this country, the author indicates how modern light sources and fittings have affected the theory of lighting application and stresses the experimental nature of the present work on lighting techniques.

By J. M. WALDRAM,
B.Sc., F.Inst.P., F.I.E.S.*

It was said recently about a famous contemporary building that "it combined the mechanical complexity and the vagueness of purpose characteristic of the day." The stricture may have been right; it referred partly to the lighting of the building, and might well have been applied to lighting generally, for our aims to-day in interior lighting are vague and confused.

Vagueness of purpose is not always deplorable. It may not imply the cessation of progress; it may arise from progress. "He who aims at the sky shoots higher than he who aims at a gooseberry bush," but he who is content to aim at a gooseberry bush has at least a target which is definite and can be hit, and he can score accordingly: but the sky has no bull; it is lofty but intangible, and he knows neither where to aim nor when he has succeeded. One reason for our present vagueness in lighting is that we are being emancipated from the simple, crude requirements of illumination, as laid down in codes, and recognise that there are subtler aims: but the new aims, just because they are more subtle, are lofty and vague, and are not yet even clearly recognised, much less codified.

An Exploratory Period

For many years past we have thought in terms of illumination and working planes and visual tasks; and although it was recognised that more lay behind them, and empirical rules were laid down concerning glare, decoration, and so forth, these basic factors were taken for granted. Illumination was codified, and could be predicted and measured; we knew what we wanted to do and when we had succeeded. But now "Brightness Engineering," foreshadowed 20 years ago, has come to be recognised as the right basis, the older ideas have lost their force. Nevertheless, we do not yet know how to prescribe brightness, and we can hardly either predict or measure it, and we have not yet built up a body of experience of it. Certainly we have given it a new name, but that has not greatly clarified matters. Consequently all sorts of ideas are being tried, quite empirically, to see what will happen and to gain experience, out of which we hope that more definite aims will emerge. They will only do so if we study and measure systematically the results of new experiments and old installations, otherwise no real experience will be built up.

We know that we are concerned with the organising of the whole visual field, using for our tools light, form and colour; we have to discover what to do with them. Obviously this is a matter of aesthetics, a subject in which aims are notoriously obscure and elude definition. It is the territory of the architect, with whom we have long shared common problems without a common approach or even a common vocabulary. It is to him that we naturally look for help, but the architect is little better off than we are where lighting is concerned. He does not know yet what can be done with light, and his interest in lighting has been mainly in the design of decorative lighting equipment, with little concern for its performance or effect—sometimes to the detriment of his own work—or to assigning some feature of his building to house the lighting equipment,

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thereby settling the lighting effect arbitrarily and tying the hands of the lighting engineer.

Organising the Visual Field: the Explorers

Various groups of explorers are about in the visual field, sometimes unaware of one another's activities. For many years one group has been concerned with visual tasks, discovering the effects of various regions of the field of view upon the speed and accuracy with which difficult visual tasks can be performed, and laying down the necessary illumination in codes. Here Weston's careful and realistic work is beginning to receive the wide recognition due to it. The British Code, based upon it, wisely refused to prescribe unnecessarily high illuminations or to go into unjustified detail, and it is a matter of satisfaction that it was agreed in Stockholm to study it as a basis for such Codes throughout the world. In America a prominent group of workers has, for many years, studied problems of seeing, for the most part on the basis of visual acuity in a more elaborate form. They developed a "visibility meter" which was, in effect, a test combining acuity and contrast sensitivity, from the indications of which recommended illuminations could be derived. The same group recognised, however, that much of seeing lay too far from thresholds for them to give much guidance, and they sought to discover the effort and "tension" of subjects performing tasks under various lighting conditions. No very clear recommendations emerged from some of these researches, however, except illuminations which seemed so high that the arguments behind them have been queried, and some unexpected effects have been found. Their aim is interesting, however—a compound of the highest possible visual acuity and effortless seeing conditions. In America a visual task is almost always assumed.

The coming of the fluorescent lamp and its very wide use has stimulated work in fresh directions. Perhaps because its obvious advantages include comfortable lighting and reduced glare, much thought has been given to both comfort and to glare, and two parties have been exploring, not very far from one another—the "Glarologists" and the "Comforticians," as surely someone on the other side of the Atlantic must call them before long. The Glarologists have turned their attention from disability glare, so thoroughly explored by Holliday in the United States and Stiles in Great Britain, and returned to discomfort glare, on which Ward Harrison and Guth in America and Hopkinson and Petherbridge in England have been at work. Some interesting and valuable data have resulted from both explorations, with rules and empirical formulae based upon rather different assumptions. Harrison has assumed a worker looking up momentarily to the horizontal, from sedentary work; his empirical formulae are based upon Holliday's work on the "shock" experienced when a glaring light is exposed suddenly. Hopkinson's formulae, based on less rigid assumptions, resulted from his investigations of discomfort in steady vision.

Both these explorers were concerned with the suppression of a particular discomfort. The Comforticians, working alongside them, have studied a rather different aspect; the unpleasing or distracting effect of certain characteristics of the brightness pattern, and the characteristics which produce the most efficient seeing. Their aim is much the same as those of the Glarologists and the Taskmasters. Guth has investigated for a series of conditions the "borderline between comfort and discomfort." The "Quality and Quantity" Committee of the American Society have sought to lay down standards based upon several of these investigations, having at the back of their mind the same assumptions as lay behind the visibility meter—high visual acuity, and the avoidance of uncomfortable contrasts. Logan has explored another territory; he measured what occurs out of doors and used it to base recommendations for what should be the limits indoors, on the assumption that we have evolved under outdoor conditions, and would dislike anything else. One outcome of these researches has been a restriction of the reflection factors of decorations to high values, as well as restrictions upon the lighting, so that our eyes might function with the least distraction.

All these workers have been concerned with a negative aim: to remove discomfort. But, as Hopkinson insists, absence of discomfort is not necessarily comfort; it may be a vacuum. In removing discomfort one usually has to remove something else, too; and when the Comforticians have had their way they will have removed character, incentive, emphasis, modelling and much that makes an interior pleasant and exhilarating. Seeing is only one part of a man; one should set out to do the best for the whole man, not for the part only. People work best when they are happy and stimulated, and we may do better if we achieve pleasant and exhilarating interiors even if it is at the expense of dull and odious technical perfection. It is curious that those lucky people who recently returned brown and vigorous

from " the best holiday they ever had " spent a fortnight in conditions of glare and lighting which defied every code.

Two other groups of explorers are busy elsewhere. One is the Decorators, who have recognised the lesson, first learned in lighting streets, that the " decorations " and the lighting are joint components of a single whole. They seek to use decorations not in the negative manner so far reached by some of the Americans, who only restrict reflection factors to avoid over-strong contrasts, but as a positive contribution in its own right. The Building Research Station in this country, and some architects, have made remarkable contributions; and it is curious that they have sometimes used deliberately surfaces of low reflection factor, judiciously applied. This may be the answer to the defect of some interiors with high reflection factors everywhere, which seem to vanish into a nearly featureless off-white fog. Interiors have to be painted, anyway; paint costs less than lighting equipment and electrical energy, it can produce crisper and more attractive colour effects than can be achieved by varying the colours of lamps, and can give more subtle emphasis. Time is well spent on deciding the best colour scheme, and it may cost little more than the worst.

With the Decorators are the Colorists, investigating the abstruse response of the eye to colour, and the effects of the colours of lamps upon the appearance of interiors, of food, furniture, faces and clothes. The two problems are complementary and fascinating. Is it better to apply colour as pigments to surfaces lit by a neutral white light, or to bathe the whole interior in light with an intentional colour bias, or by a mixture of both methods? Some very interesting results are emerging about the subtleties of colour appreciation and colour adaptation from work all over the world.

Yet another group of explorers are the Modellers, interested in the ways in which interior forms and architecture are revealed; in effects of directional light in showing form and texture; in producing shadows and reflections, and " the use of light for emphasis and emotion."

Others in this country, America and Sweden are studying daylight in interiors, not confining themselves to methods of calculating its amount but observing the daylight appearance of interiors and its relation to glare, brightness patterns, decoration, and many of the factors mentioned already.

Finally, there are the Computers and Approximators—a field of work in which the Americans excel, working out approximate methods of estimating and predicting brightness, glare factors and other quantities which we shall certainly want to know, reducing to handy tables what would otherwise involve difficult and impracticable mathematics. Moon and Spencer's interreflection tables and Harrison's glare ratings are contributions of immense value which have not yet been properly recognised.

Mapping the Results

The results of all these explorations trickle in; some relevant, some misleading, some incomplete. We do not understand half of them fully yet; most of all, we have not yet the body of experience in the new techniques to know what they mean. We are like the doctor who first thought that there might be some significance in body temperature, and who measured a patient's temperature and found it 102 deg. F., but did not know whether it was up or down, nor what conclusions to draw. The bringing together of all these data has yet to take place, and it will only be done by judgment enlightened by experience. One day we shall join with the architect in the very early stages of the conception of an interior, working out together forms and colours and textures, deciding upon foci of attention, on how to achieve them by combinations of form, decoration and lighting: placing shadows effectively; arranging the flow of light in the interior in harmony with the architecture; ensuring that people can be seen attractively, and can see without discomfort or distraction; and engineering the lighting and electrical equipment to bring about these effects. It will be an artistic creation, our part of it expressed in luminance and reflection factors and angles, and the architect's in feet and inches and bricks and mortar. In solving the various compromises, we shall need the results of all these explorations and all the simplifications and approximations we can find. The techniques for all this are not yet in existence, but they will come.

Some Results

Already several results have emerged from drawing these explorations together. The importance of the user's field of view is recognised, and in America it is being plotted on a web rather like a perspective—a technique already established here in street lighting and aviation lighting. This is quite a fundamental step of great importance.

A second very important result is the recognition of the marriage of lighting and

decoration and surfaces, the latter being as much part of the installation as the lighting fittings—another conception already established in street lighting. The lighting engineer is increasingly being asked to advise upon decoration, though he does not yet always know what to answer.

A third result is the harmonising of the techniques of daylight and artificial lighting. Hitherto they have been considered as separate problems, calculated by different methods, expressed on different bases and having different requirements, as though the eye behaved differently under the two illuminants. That is obviously not so; here is an artificial discrepancy from which there must be much to be learned. For example, daylight is expressed conveniently as a ratio, which turns out also to express fairly well the visual experience; this can be explained by adaptation phenomena. But artificial light has always been expressed absolutely; it has been assumed that the eye possessed a perception of absolute level in artificial light which it lost in daylight. Why? It may be that the ideas of adequate artificial illumination may have something to learn from consideration of daylight, and may eventually be expressed analogously. Again: daylight has always been calculated as from a large-area source to which the inverse square law could not apply; artificial light has been calculated either by the flux method or by the point-source-and-inverse-square-law conception. But now that artificial lighting is a matter of large panels or long lines, analogous methods have to be applied to both, and probably they will find common ground in inter-reflection methods—which were first applied to problems of daylight in light wells, and which are a variant on the flux method.

Though conscious new lighting techniques have not yet emerged from the new work, it is possible to discern an experimental trend, particularly in American practice. The following may be an over-simplification, but it may stimulate thought. Some of their researches indicated the need for high illuminations, which were achieved using suspended fittings. This made it difficult to avoid glare, so the old device of indirect lighting was advocated but at much higher levels. This, with tungsten lamps, involved a high loading, so much so that trouble with heating occurred; moreover, the effect was flat, and at the higher levels (at which the tolerable brightness range begins to shorten, especially at the upper end) the bright ceiling was troublesome. At this point the fluorescent lamp became available, and was tried at first bare, for it was intended that it might be so used. But increased efficiency of the lamps increased their brightness, and the glare became too great. However, the lamp made possible high illuminations at much lower loadings, and various methods were tried. They all required large numbers of lamps, for which suspended fittings were overpowering, so that more convenient engineering was adopted, such as continuous twin-lamp troughing, "troffers" which covered a false ceiling with continuous lines of sources, and so forth. Then someone had the ingenuity to use louvres, hitherto made black for controlling unwanted light by absorption and very inefficient, but painting them white instead. The results were surprisingly good, the fitting brightness being not too high and yet the illumination high and the modelling fairly good, and the efficiency tolerable. The ultimate development along this line is the use of the completely louvred ceiling with lamps above it. One American writer is, however, contesting this development on the score of reflected glare, and is advocating luminous ceilings with opal diffusers, which is surely optically identical with the indirect lighting of 15 years ago and which can be expected to have the same defects, except those of high loading and visible fittings.

Many engineers, however, doubt whether the louvred ceiling is the final word, interesting as it is. But in whichever way we go, it seems likely that it will be away from the use of suspended fittings, except in period rooms. Whether we use built-in lighting panels, concealed spotlights, false ceilings, or other devices, it is scarcely likely that we shall develop the individual lighting fitting suspended in the space to be lighted, obstructing the vistas and resulting in a confused modelling and shadow system. Even in industrial lighting, where fittings are and probably always will be used in some form (so long as we retain our ideas about daylight) they are becoming more and more like structural members. The latest device of extruded aluminium troughing, strong enough to carry all the gear, reflectors and wiring and, if need be, the maintenance man as well, is a remarkable development, leading to neat and simple equipment, a great convenience in installation and a saving in the cost of wiring.

The most recent technique in interior lighting seems to be the combination of fluorescent and tungsten filament lighting, sometimes with the additional feature that the tungsten lamps form the ballast for the

(Continued on p. 340)

Projector-Arc-lamps for Motion-Picture Presentation

In a previous article the author dealt with viewing conditions in the cinema. In the following article the arrangements for projecting good quality pictures are described.

By R. PULMAN, F.B.K.S.*

One of the constant aims of the specialist lighting engineer in the field of motion-picture presentation is that of providing an adequately, evenly and consistently illuminated picture image. British Standard No. 1404: 1947, states that the screen brightness should lie between eight and 16 foot-lamberts and should be measured normal to the screen with the projector running and no film in the gate.

If we are to achieve the top range of recommended brightness then we should aim at around 14 foot-lamberts and on taking the normal figure of 70 per cent. reflection factor for the flat-white diffusive screen in use in the majority of motion-picture theatres, we find that we need an incident illumination of about 20 foot-candles at the centre of the screen. Taking the matter one step further and allowing for a side-to-centre ratio of 0.7 to 1.0 then we need an average foot-candle reading of 16.

In this country screen sizes are likely to exceed the minimum laid down internationally for any particular auditorium seating layout and dimensions. We therefore find that the peaks of screen sizes are to be found around the 20-ft. width, the 22-ft. width, and the 24-ft. width with the latter as perhaps the most popular. A 24-ft. picture width will give an 18-ft. height under normal conditions and an area of 432 sq. ft. The aperture through which the light must pass to the screen is about one half of a square inch in area while the resultant image size will have an area of 62,208 square inches. To illuminate this picture image to the B.S.I. standard of 16 foot-candles average, one must obtain at least 7,000 lumens.

To obtain this high light output from the motion-picture projector after taking into consideration the many unavoidable light losses from light source to projection-lens, a very bright light source is needed and at the moment the carbon-arc reigns supreme.

Over a period of years the carbon-arc light source for motion-picture projection has passed through a series of very important development stages.

Not very long age the projector-arc-lamps in use were of the Low Intensity type utilising carbon-electrodes of pure carbon, having an intrinsic brilliancy figure of around 180 c.p.sq.mm. The light output of this type of arc was strictly limited by the volatilisation temperature of carbon and the colour of the light was rather biased to the red end of the spectrum. Later the High Intensity arc was introduced, embodying electrodes impregnated with cerium fluoride and utilising an incandescent gas ball as the light source with intrinsic brilliancies that rose through the development stages from 380 to nearly 1,000 c.p.sq.mm.

The small diameter copper sheathed electrodes in use to-day have high current densities and give adequate light output when coupled with the efficient optical systems of to-day. The most usual combination is an 8 mm. diameter positive electrode of between 12 in. and 18 in. in length and a 7 mm. diameter negative electrode of between 8 in. and 12 in. in length burnt at a current of 65 amperes and with an arc voltage of 40. There are other combinations available for different operating conditions.

The housing in which these electrodes are burnt is called the projector-arc-lamp and is a combination of a mechanical and an

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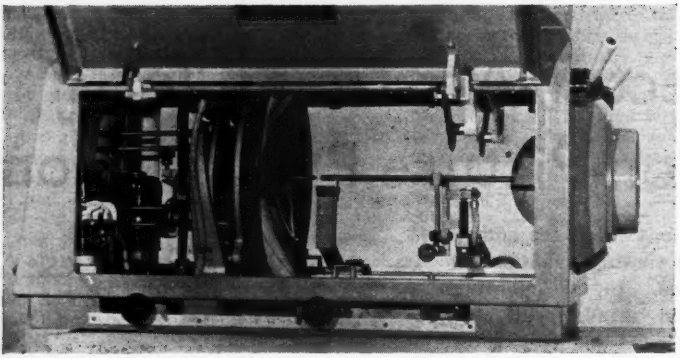


Fig. 1. Showing a projector-arc-lamp.

optical system. One of the three primary functions of the projector-arc-lamp is to provide a means whereby the positive and negative electrodes can be located and firmly gripped in perfect alignment, the positive electrode horizontally along the optical axis of the projector-arc-lamp and the negative electrode either horizontally or at a predetermined angle to the positive electrode.

The second of the primary functions is to provide a means whereby electrical energy may be fed separately to each electrode without any deterioration of flexible cables which might be caused by the great heat generated inside the lamphousing, and the third primary function is to provide a means whereby the electrodes may be moved forward as they are consumed when the arc is burning.

The first function is achieved by holders that grip the electrodes firmly but gently and guides that locate the electrodes in their correct positions. Since the optical system of a modern projector-arc-lamp is almost invariably a large diameter concave reflector, the end or crater of the positive electrode must be guided to the exact position that will ensure its efficient optical presentation to the light-collecting reflector. On the other hand the negative electrode is a form of electron gun, and its point must be located in correct relationship to the positive crater.

The second fundamental is achieved by insulating the carbon holders from the framework of the lamphouse proper and using flexible cables to allow for the required movement of the electrodes.

The third fundamental requirement is necessary because as the electrodes are burnt in the form of an arc or discharge they are consumed at a steady rate, and unless they are moved forward constantly the distance between them will increase and will eventually fail to support the arc. This function is satisfied by mounting the holders on guide rails and in contact with feed screws which when rotated will have the effect of moving the carbon holders forward or backward as required, the controls being brought outside the lamphouse for manual operation.

At one time it was possible to feed the carbon electrodes by hand for at the relatively low current densities of low intensity carbons the burning rates were also so low that the arc could be fed about every minute without the positive crater moving out of the range within which screen illumination would remain reasonably constant. In these days of supercharged electrodes and, therefore, high burning rates it is impossible to feed an arc by hand except in emergency and for a very short period of time.

The feed screw or screws are, therefore, linked mechanically with an electric motor or motors which carry out the feeding system continuously or as required without any attention. The small carbon electrodes have burning rates of up to 20 in. per hour and some form of automatic and continuous feed is necessary to ensure that the positive crater is maintained at the correct position and that the negative electrode keeps the arc gap length constant.

Automatic feed systems generally take the form of low voltage D.C. motors connected across the arc gap and responding to the arc voltage so that when the electrodes burn away and the gap tends to open the voltage drop increases. This voltage drop being impressed across the feed motor, speeds it up and thus closes the gap to the correct

length. The system therefore operates semi-automatically and master control of speed is effected by a rheostat which can be set manually to suit any variations in average burning rate.

Where one feed motor only is used it is necessary to provide some form of mechanical device that will afford means of varying the feed ratio between the positive and negative carbons as otherwise only one particular carbon combination may be used at within close limits of voltage and current. With a variable feed ratio system the speed of the positive feed is first set by means of the rheostat and then the variable feed ratio device adjusted to suit the negative feed speed. One particular projector-arc-lamp incorporates two feed motors, feeding the positive and negative electrodes separately thus giving a very wide range of feed ratio.

Not only is it necessary to have the right length of gap, but the gap as a whole must not "creep" in either direction so a refinement is fitted to certain projector-arc-lamps consisting of a photo-thermal relay and optical system that automatically ensures the correct position of the positive crater over any period of time. Where such an automatic focusing device is fitted, the negative speed is first set by means of the rheostat for the device will automatically deal with positive feed speed. Some feed motor systems incorporate a relay which starts and stops the motor as required by the arc gap length, the relay being sensitive enough to operate within the allowable range of movement of the positive carbon electrode's crater to or from the face of the reflector.

In order to start the arc between the electrodes the line voltage is connected across them and they are gently touched together when, on being withdrawn to their correct positions, the arc forms between them. Until recently the operation of "striking" the arc was carried out manually by using the feed controls, but on modern projector-arc-lamps this operation is carried out in a more simple manner by push-button control or a scissors control. In more than one projector-arc-lamp the operation is entirely automatic through a solenoid which moves the negative forward to touch the positive crater and then withdraws it to the correct

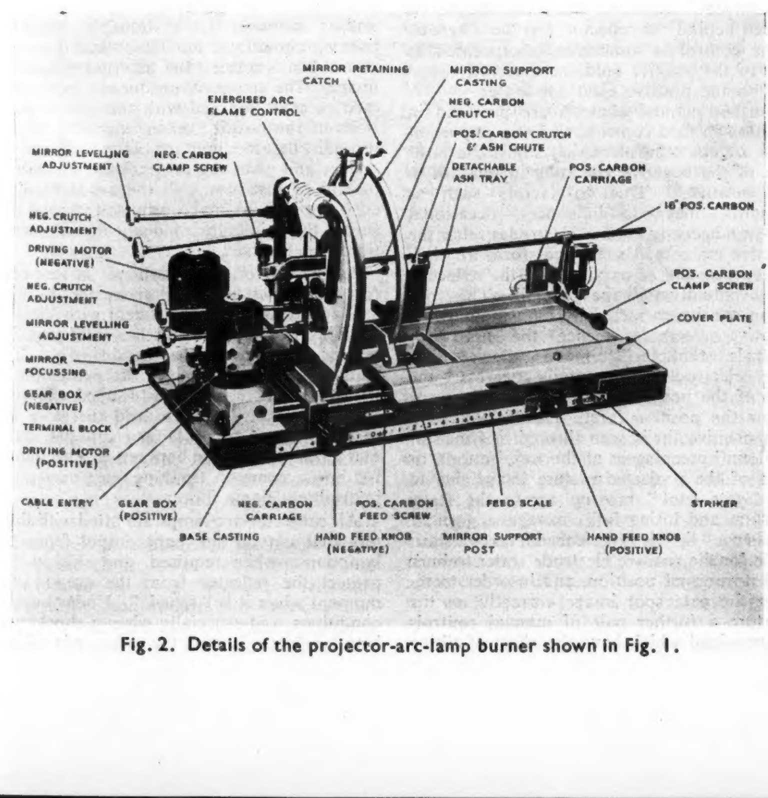


Fig. 2. Details of the projector-arc-lamp burner shown in Fig. 1.

distance. This automatic striking takes place immediately voltage is applied to the electrodes. The operation of "striking" is a delicate one, for it is very easy to break the thin carbon walls of the crater and thereby release the gas ball which is confined therein. Such a fracture in the carbon results in the screen illumination turning temporarily to the characteristic "brown" colour of incandescent carbon until the crater re-forms and the gas ball becomes the light source again.

Steadiness of the arc is a very necessary factor to consistent screen illumination and the magnetic flame control with which most modern arc-lamps are fitted helps considerably in this direction. Further advantages of the magnetic flame control are corrected tail-flame position, better compression of the incandescent gas ball and higher arc wattage for a given gap length. In some cases the magnets are of the permanent type, such as the powerful "Hy-Ax" Alnico magnet fitted to the Peerless "Magnarc" projector-arc-lamp. In other cases, such as the range of G. B. Kalee projector-arc-lamps, the magnets are electro-magnets, the windings carrying the arc current, and thereby varying the magnetic-field strength in accordance with variation in arc current. In most cases the magnet is placed behind the reflector, but the magnetic flame control is sometimes incorporated as part of the positive guide-head directly adjacent to the positive electrode crater.

Further manual controls are provided in addition to feed controls, and two important ones are the controls which adjust the position of the negative electrode in relation to the positive. Due to factors such as draughts, magnetic influences, occasional non-homogeneity of the electrodes, etc., the positive crater will sometimes form a "lip," i.e., become out of parallel with the reflector, and eventually spill the gas ball. This condition can be corrected by repositioning the negative electrode, hence the need for controls that will move the negative electrode horizontally across the face of the positive and vertically above or below the positive face. The visible result of a positive lip is seen through a fringe of "colour" creeping in at the top, bottom, or sides of the projected picture image due to the "gate spot" moving across the static aperture and losing full coverage.

When a "lip" is experienced it takes a short while for the positive electrode crater to burn back to normal position, and in order to re-align the gate spot image correctly on the aperture a further pair of manual controls are provided which have the effect of tilting the reflector up and down and from side to side.

The aperture in a film-mechanism is rectangular, being 0.825 in. in width and 0.600 in. in height. The image of the carbon electrode's crater is circular and slightly out of focus and must be at least 1.500 in. in diameter to completely cover the aperture without any colour fringe.

When carbon electrodes are burnt in an arc there is a certain amount of ash deposit as the carbon volatilises, and access to the inside of the lamphouse and the arc burner is very necessary if the mechanisms are to be kept clean and free from maintenance troubles. In many designs the arc burner is easily removable from the lamphouse proper for easy maintenance. The modern carbon electrodes are coated with a thin sheath of copper to assist the conduction of the electrical energy to the crater and tip of the electrodes. This results in a certain amount of copper drippings as the sheath becomes molten, and these drippings are generally guided down a channel into a drip tray when the solidified globules can be regularly removed.

An external image of the burning arc is another necessity to consistent screen illumination. The inclusion of a voltmeter and/or ammeter is a valuable guide to burning conditions, but these should supplement, not replace, the external magnified image. The image is produced, on a small card or plate marked with the correct positions of the positive crater and negative tip, through the medium of a small optical system and gives the projectionist a constant picture of just how well the arc is burning, enabling him to make adjustments and ensuring the minimum of delay in the correction of a fault.

At the top of the lamphouse is an outlet for the fumes resulting from the burning arc. This is generally fitted with flexible trunking to connect up with a solid trunking system leading to the outside air. The efficacy of the system for the extraction of the arc fumes has a very decided effect on the steadiness of the arc and therefore the screen illumination. Down draught, poor extraction, interaction between two arc-lamps fed into a common trunking, etc., may cause intermittent flame flicker.

All projector-arc-lamps are fitted with shutters that cut off the light output from the lamphouse when required, and shields that protect the reflector from the arc at the moment when it is "struck." Under normal conditions, and especially when a short focal length reflector is used, the reflector is subject

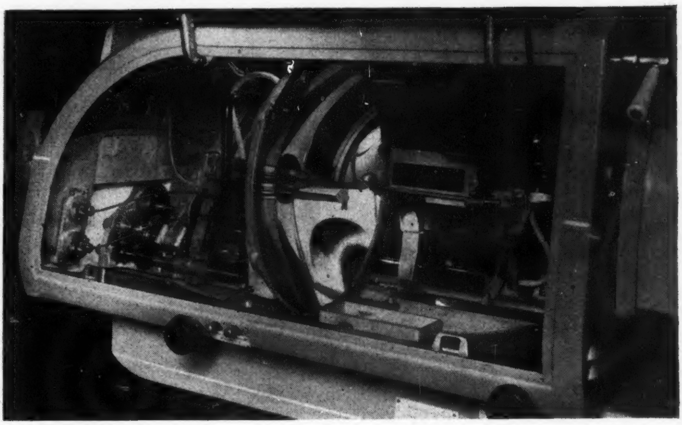


Fig. 3. Interior of the projector-arc-lamp showing large diameter reflector and other detail.

to "pitting." This is brought about through the ejection of small incandescent particles of cerium from the positive core. These white-hot particles hit the surface of the glass reflector and embed themselves in the surface lowering the total reflection area and in time necessitating the replacement of the reflector. When the two electrodes are "struck" there is greater danger of core ejection, and since at that time no light is being projected to the screen, the use of a dowser or shield will prevent unnecessary pitting. The main dowser and the striking shield are often mechanically interlinked to make sure that the shield is in position before the arc is struck.

Some arc-lamps are fitted with a removable heat-resisting glass filter or lens at the aperture where the light leaves, and this has the advantage of acting as a steadying influence on the arc, especially if the film-mechanism rear shutter is of the type likely to cause air turbulence. Draught that is unwanted can cause quite a lot of trouble, not only affecting consistency of screen illumination but also creating excessive burning rates of the electrodes and frequent lipping of the positive electrode.

The reflector will become clouded with a deposit of arc ash and needs frequent cleaning. Easy release from or with its housing will make this maintenance job simple.

Examples of modern projector-arc-lamps include the G. B. Kalee "President," which incorporates a 14-in. diameter reflector, independent feed motors for positive and negative electrodes, and a manually operated striker. The carriage will accommodate an 18-in. length of positive electrode and a 10-in. length of negative.

The G. B. Kalee "Lightmaster" uses a 16-in. diameter deflector, with a minor conjugate of 6 in. and a major conjugate of 36 in., and is designed to utilise the maximum of the available light output from the source. This arc-lamp has an orthodox feeding system, variable feed ratio being obtained through a mechanical device. Manual "push-button" striking is fitted.

The G. B. Kalee range of projector-arc-lamps also includes the "Universal," which has been designed to use either Low Intensity or High Intensity electrodes fed with either D.C. or A.C. A 12-in. diameter elliptical reflector is fitted.

The famous B.T.H. range of S/U/P/A projector arc-lamps includes the "H," "K," and "L." The "H" and "K" embody a 14½-in. reflector, working in the first case at 4⅝ in. x 32¾ in., and in the second case at 5⅛ in. x 33¼ in., and are designed round one particular carbon electrode combination. The "H" uses a 7-mm. positive and a 6-mm. negative electrode, and runs at 50 amperes, 41 arc volts, while the "K" uses a 10-mm. positive and a 7-mm. negative electrode run at 75 amperes. The aperture values are f.1.9 and f.1.8 respectively, and such refinements as automatic striking and automatic focusing are fitted. The "L" type arc-lamp embodies a variable feed ratio, and has a recommended rating of between 40 and 50 amperes. It utilises 12-in diameter reflector working at 4¾ in. x 29 in., and has an aperture value of f.2.2.

There are many other outstanding

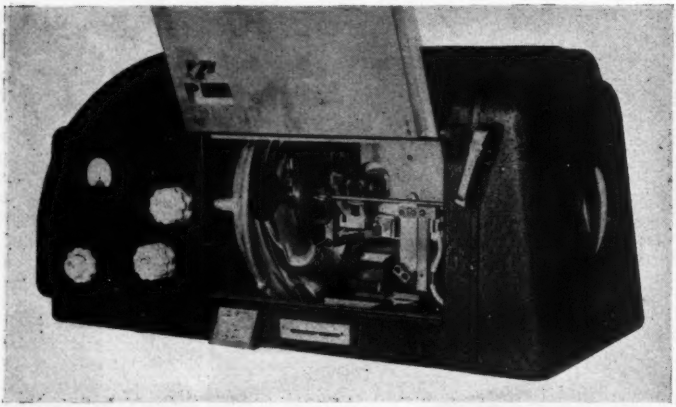


Fig. 4. Type 'K' projector-arc-lamp.

projector-arc-lamps, such as the Peerless "Magnarc," the Ross "Streemlite," but all are basically similar in their functions. They provide the specialist lighting engineer with a wide choice, and each has its special points of appeal. Modern practice is to design an arc-lamp that is physically and optically suited to the film-mechanism and projection-lens, of which it is an integral part, such as in the G. B. Kalee "G.K.21" Projector, the B.T.H. S/U/P/A Projector, etc., and one can be assured of trouble-free and semi-automatic operation, consistent and adequate light output, and every satisfaction from the range of modern projector-arc-lamps available to-day.

Several interesting developments have taken place in the U.S.A., where the need for greater light output has been brought about by the large screen areas in "Drive-In" theatres, but how they will affect the position in this country is not clear at the moment.

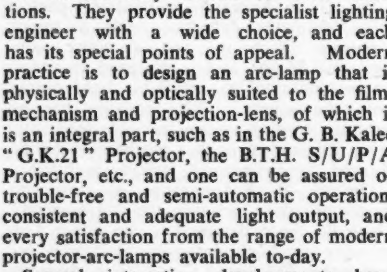


Fig. 5. Diagram of the arc striking solenoid circuit.

Lighting Aims and Techniques

(Continued from p. 334)

fluorescent lamps. In industrial lighting, for high bays, combinations of high-pressure mercury vapour and tungsten lamps are being used. The complication of these systems may defeat them; but there is the possibility of producing a pleasing variety of colour and directional effects which may be a great improvement on the deadly uniformity beloved only by the engineer. Perhaps the most important lesson to be learned is that a controlled variety is far more pleasing than uniformity. It can, however, be designed only when the use to which the interior is to be put is known fairly well in advance. If it is not, either the lighting must be made flat and uniform so that the users can be equally dull everywhere, or we must design lighting systems as flexible as office equipment and partitions, and train house engineers who will readjust it intelligently.

Festival Floodlighting

Acknowlidgment is made to the General Electric Co., Ltd., for permission to reproduce on page 330 the photograph taken at the Festival Pleasure Gardens. The tower shown in the illustration is one of a pair, each illuminated by four G.E.C. floodlights.

Load Shedding and Light Sources

This article deals with the effect of voltage and frequency reduction on tungsten and fluorescent lamps, and the author draws certain conclusions on lamp performance under the condition of load-shedding likely to be experienced in this country for some time.

by D. F. CHAPMAN,
Graduate I.E.E.*

Electricity "load-shedding" and "power cuts" during the winter months in Great Britain will continue for at least a number of years until sufficient generating plant and distribution equipment is installed to meet the peak or maximum load demand. Lighting is particularly affected when load shedding and voltage reductions occur, and an understanding of the variable factors involved is of importance to all concerned with artificial lighting. The aim of the present article is briefly to review the subject from the point of view of the lighting engineer rather than from that of the electrical engineer.

Load Shedding

During peak periods, which vary both in duration and time according to the weather, the connected load on the supply system exceeds the capacity of the generating stations. Since electrical energy cannot be stored on a large scale, supply and demand must be balanced at all times, and to maintain equilibrium the load must be reduced. At the present time it is estimated that the maximum demand exceeds the available plant capacity by about 1½ million kw.

During the first stages the load is reduced by lowering the supply frequency and voltage, and in this way partial load shedding is obtained without actually interrupting the supply to consumers. Voltage and frequency reductions can only be made to a certain level, and if further reduction of load is necessary, the next step is to cut the supply to some consumers immediately.

Voltage reduction is carried out on the low voltage side of the distribution networks and is usually made in two steps of about 5 per cent. each. Abnormal voltage drops can also occur in supply cables and equipment when these are heavily loaded, with the result that a drop greater than 10 per cent. can be experienced by the consumer. In actual practice, drops of as much as 20 per cent. or more in supply voltage can be encountered at the time of peak load.

It is evident, therefore, that the total amount of voltage drop which occurs depends upon the position and characteristics of the feeder to which the consumer is connected, and for this reason it is impossible to state exactly the maximum voltage drop likely to be encountered by consumers as a whole.

Frequency reductions can, however, be stated with certainty, and the maximum drop which occurs is from 50 to 48 cycles per sec., or a reduction of 4 per cent. It is of interest to note that frequency is usually increased above 50 cycles during certain off-peak periods so as to maintain the timekeeping of electric clocks.

Effects of Voltage and Frequency Reductions

Tables I and II show the effect of 20 per cent voltage and 4 per cent. frequency reductions upon lamps of various types. The data for the 5-ft. 80w. fluorescent lamp is based upon inductive, capacitive and resistive ballasting methods. The values are approximate and depend to a certain extent upon ballast design and tolerance.

In this country the majority of hot-cathode fluorescent lamps are stabilised by an inductive or choke ballast, and power factor correction is obtained by connecting a suitable capacitor across the main supply. A "capacitive ballast" comprises a capacitor in series with a choke, but since the resultant

* Thorn Electrical Industries, Ltd.

impedance is capacitive the ballast is given this name.

Data is based on an ambient temperature of 20 deg. C. and a declared A.C. supply of 230 volts. The effects can conveniently be considered under a number of separate groups.

Light Output

For any type of lamp a reduction in supply voltage causes a reduction in lamp current and wattage and a drop in light output. The characteristics of the fluorescent lamp ballast or transformer play an important part in determining the effect of supply reductions upon the lamp itself, but in all cases the light output from the tungsten filament lamp drops far more than that of fluorescent lamps for a given voltage reduction.

Light output from fluorescent lamps controlled by inductive or capacitive ballasts also changes slightly with reductions in supply frequency. In the case of the inductive ballast the effect of frequency drop alone is to reduce ballast impedance and cause a slight increase in light output. On the other hand, a frequency drop causes the impedance of the çapacitive ballast to increase, and light output from the lamp is slightly decreased.

The change in light output and circuit characteristics due to frequency variations is small compared with the effects due to voltage variations. Frequency changes have no effect upon the light output from tungsten lamps or resistively controlled fluorescent lamps.

One point of interest is that, with voltage reductions, the light from the tungsten filament lamp is not only reduced but also changes slightly in colour, due to the drop in filament temperature. The colour of the light from fluorescent lamps does not change with reductions in lamp current.

Efficiency.

The efficiency of the tungsten filament lamp falls off rapidly as supply voltage, and hence filament temperature, is reduced. The overall efficiency of any fluorescent lamp circuit depends not only upon the efficiency of the lamp itself but also upon power losses in the control and starting equipment. When the current through the ballast is reduced as a result of supply reductions, the power loss in the ballast is decreased. In the case of a resistor ballast, the loss is proportional to I^2R, and the result is a relatively large increase in overall circuit efficiency with reductions in current I.

In addition to reductions in ballast losses with corresponding gains in circuit efficiency, the fluorescent lamp itself, with reductions in lamp current, gives less lumens, but these lumens are generated more efficiently in terms of lumens per lamp watt.

The explanation, very briefly, is that reduction of lamp current causes a drop in lamp temperature and hence a drop in mercury vapour pressure. This results in an inincrease in the proportion of 2537 A.U. ultra-violet radiation generated with a corresponding increase in the proportion of visible light.

The resultant effect of reduced ballast losses and increases in lamp efficiency is to give a fairly considerable rise in the overall efficiency of fluorescent lamp circuits.

It should, however, be remembered that the drop in light output is not made good by the increase in efficiency.

Stability

If the voltage supplying a fluorescent lamp circuit is slowly reduced, a point will eventually be reached at which instability occurs and either the lamp suddenly extinguishes or the starter-switch recloses and causes the lamp to blink on and off. The minimum supply voltage at which conditions in the circuit will remain stable depends not only upon the type and design of the ballast but also, in the case of the hot-cathode lamp, upon the type and design of the starter.

Table III shows that the capacitive ballast maintains greatest stability under conditions of voltage drop. Similarly the electrode heating starting transformer will permit the lamp to withstand the greatest reductions in supply voltage.

The cold-cathode lamp, because of the better inherent regulation of the circuit, is able to withstand voltage reductions of at least 20 per cent.

Lamp Life

The life of tungsten filament lamps is of course greatly increased by operation at reduced voltage since the reduced temperature results in a lower rate of filament evaporation.

The life of the hot-cathode fluorescent lamp, for a given ballast, is in general dependent not only upon the number of burning hours but also upon the number of starts. Operation for long periods at reduced current, and frequent switchings on and off under similar conditions, may cause reduction in lamp life.

The life of a cold-cathode lamp is little

affected either by operation at low currents or by the number of starts.

Lighting Costs

Because the supply reductions vary from hour to hour, day to day and place to place, their effect upon lighting costs is complicated and cannot be estimated with any accuracy.

The annual cost of a lighting installation can be divided into four main charges: annual depreciation and maintenance costs, annual lamp replacement costs, cost of electricity consumed every year, and maximum demand charges. Each one of these charges can alter as a result of load shedding.

For all light sources, supply reductions result in a reduction of overall power consumption with corresponding reductions in the number of kwh. consumed.

Lamp maintenance and replacement costs are affected by the resultant changes in lamp life. Tungsten filament lamps will outlast their rated life and have to be replaced less frequently. Hot-cathode fluorescent lamps, on the other hand, will probably have a life which is shorter than the rated value if operated continuously at abnormally low voltage, and will have to be replaced at more frequent intervals.

Maximum demand charges, if on a kVA basis, may also vary due to changes which occur in the power factor of fluorescent lamp circuits. This change is shown in Table I.

Comparison of the cost of various lighting systems is usually made on the basis of obtaining equal luminous flux on the working plane. That is to say, the annual cost of obtaining a certain level of illumination with one type of lamp is compared directly with the cost of obtaining the same illumination with another type of lamp, assuming throughout a fixed number of burning hours and a fixed cost of electrical energy.

If we now consider the effect of supply reductions upon the cost of fluorescent and incandescent lighting systems which at rated voltage and frequency give an equal level of illumination for, say, an equal annual cost, it is seen that resultant changes in efficiency, lamp life and maximum demand will no longer make the cost of the two systems equal, and the cost per lumen of light from the fluorescent system will now be less than that from the incandescent system.

In the case of fluorescent lamps the running cost per lumen of light is decreased and the cost of lamp replacements increased while for incandescent lamps the running cost per lumen of light is increased and the cost of lamp replacements decreased. The overall result is that the reduction in the running cost per lumen of fluorescent lamps more than offsets the reduced incandescent lamp replacement costs and the annual cost of the fluorescent system will now show a saving over the incandescent system, the

Table I

The Effect of 20 per cent. Drop in Supply Voltage upon Light Sources.

Light Source	200 W. Tungsten Incandescent	120 mA Cold Cath. Fluorescent	5 ft. 80 watt Hot Cathode Fluorescent		
Method of Control	—	H.V. Leak Transformer	Series Inductor	Series Capacitor	Series Resistor
Per cent. change in light output	–55	–25	–30	–10	–35
Per cent. change in overall watts	–30	–35	–45	–20	–60
Per cent. change in overall efficiency	–35	+10	+20	+10	+60
Change in Circuit P.F.	Nil	0.9 Lag to 0.9 Lead	0.85 Lag to 0.9 Lead	0.5 Lead to 0.6 Lead	Nil

Table II
The Effect of 4 per cent. Drop in Supply Frequency upon Light Sources

Light Source	200 W. Tungsten Incandescent	120 mA Cold Cath. Fluorescent	5 ft. 80 watt Hot Cathode Fluorescent		
Method of Control	—	H.V. Leak Transformer	Series Inductor	Series Capacitor	Series Resistor
Per cent. change in light output	Nil	+4	+3½	–4½	Nil
Per cent. change in overall watts	Nil	+6	+5	–7	Nil
Per cent. change in overall efficiency	Nil	Negligible	Negligible	Negligible	Nil

Table III
Approximate per cent. drop in Supply Voltage which will produce unstable operation of 80 Watt Hot Cathode Fluorescent Lamps

Ballast Type	Type of Starting Device		
	Glow Switch per cent.	Thermal Switch per cent.	Electrode Heating Transformer per cent.
Series Inductor	30	15	30
Series Capacitor	40	30	45
Series Resistor	15	15	25

amount of which will depend upon the extent of load shedding by voltage reduction.

Conclusions

Under present supply reductions fluorescent lamps are superior to incandescent lamps with respect to changes in light output, efficiency and colour but lamp stability and life may be adversely affected by abnormal operation at reduced voltages. Fluorescent lamps show a saving in cost per lumen particularly if the supply reductions are considerable.

The ability of the fluorescent lamp to withstand voltage and frequency fluctuations depends to a great extent upon the auxiliary control and starting equipment and correct design and selection of this equipment can do much to reduce dislocation during "load shedding" by voltage reduction.

The author wishes to acknowledge information given by engineers of the Yorkshire Electricity Board and to thank Thorn Electrical Industries, Ltd., for permission to publish the article.

C. and G. Courses

In addition to the courses for the City and Guilds examinations in illuminating engineering mentioned on page 325 of the last issue of LIGHT AND LIGHTING, courses for the Intermediate examination are also available at the Cardiff Technical College, the Manchester College of Technology, the Belfast College of Technology, the Stow College School of Engineering, Glasgow, and at the Nottingham and District Technical College. Details of the courses can be obtained direct from the colleges or from the hon. secretary of the local I.E.S. Centre.

Lighting on the Ocean Monarch and the Ruahine

Lighting plays an important part in the interior decoration of passenger-carrying ships, and in all new and refitted vessels a high standard of modern lighting is achieved.

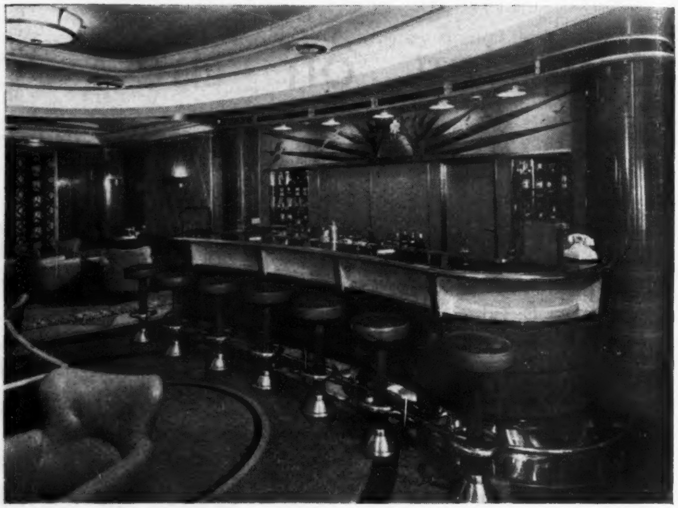
Fig. 1. The lounge on the Ocean Monarch.

During the last few years a number of new ocean-going vessels have been built in this country, and many others have been re-equipped. Ships set a high standard of furnishing, largely owing to the fact that they are a constant advertisement overseas for the skill and taste of the country of origin.

Two recently completed vessels are the t.s.s. Ocean Monarch, built for Furness,

Fig. 2. The Coral Café on the Ocean Monarch.

Fig. 3. The bar in the smoke-room of the Ocean Monarch.



Withy and Co., Ltd., by Vickers-Armstrongs, Ltd., at Newcastle-on-Tyne, and intended for the New York-Bermuda run, and the m.v. Ruahine, which is a passenger and refrigerated cargo motorship built for the New Zealand Shipping Co. by John Brown and Co., Ltd., for service between this country and New Zealand. The lighting in the public rooms of the Ocean Monarch, and the fluorescent lighting and the main tungsten lighting on the Ruahine, was supplied by the General Electric Co., Ltd.

The electric lighting in the public rooms of the Ocean Monarch is an excellent example of planned modern marine lighting. Each room was given individual attention by the architect for the interior decoration, the illuminating engineers and fittings designers (A. McInnes Gardner and Partners) in order to achieve the perfect harmony of lighting and décor which is necessary to achieve character and distinction.

Most of the public rooms of the ship, including the dining saloon, the Coral Café, the lounge, the smoke room, and the cocktail bar, have been fitted with a judicious combination of cold-cathode fluorescent tubing and tungsten lighting is used, with gold and warm-white as the chief

Fig. 4. A corner of the lounge on 'A' deck of the Ruahine.

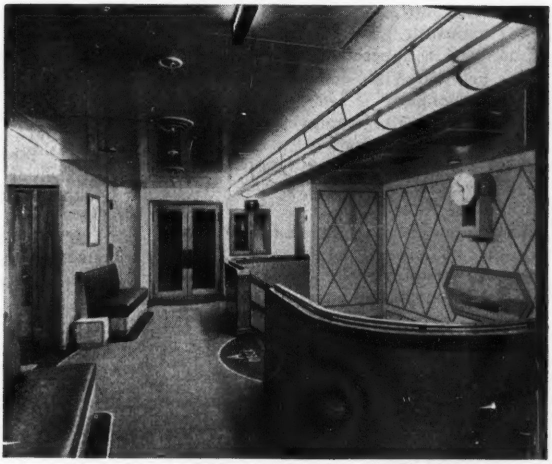


Fig. 5. Stairhall on 'A' deck of the Ruahine.

fluorescent colours. This mixture creates a pleasant atmosphere and is one which most people find agreeable.

The dining saloon has an approximate area of 2,000 square feet and is lighted by means of cold cathode tubes in a central lighting feature of 24 specially treated glass panels in a suitable framework. This is lighted indirectly by the cold cathode tubing and is bounded on three sides by a flush-glazed and louvred trough fitting. Each outboard area has three recessed rectangular ceiling panels, illuminated indirectly by cold cathode tubing from cornices, while at each of the extreme outboard sides there is a continuous run of cold cathode tubing concealed in a cornice trough. Additional lighting is by means of various fittings containing cold cathode tubing or metal filament lamps.

Forty-four special designs were made for the fittings in the public rooms, and a total of 230 tungsten fittings was supplied, ranging from 6 inches to 6 feet in diameter. Most of the visible metalwork of fittings is of polished silver-bronze, although some employ a combination of silver-bronze and bronze, or silver-bronze and gilt. Three main types of diffusing glass are used,

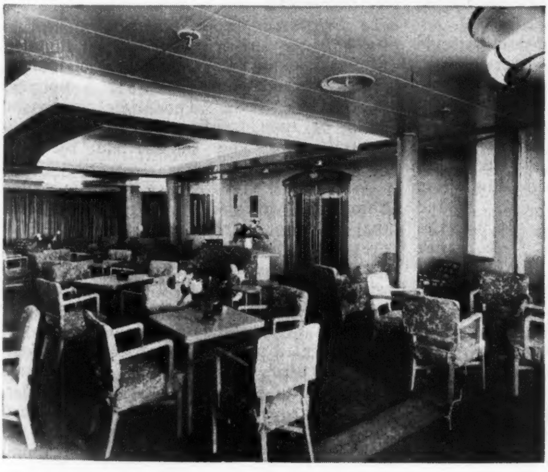


Fig. 6. The lounge on 'A' deck of the Ruahine.

"scrumbled surface," "pinhead morocco," and "luminating," and the dominant colour of the glass is a peach tint.

The lighting of the Ruahine also has been carefully designed to enhance the colour scheme, and it also employs both tungsten and fluorescent lighting. All the designs for the fluorescent and the main tungsten fittings were produced by the architects, Messrs. Easton and Robertson.

The largest fitting is situated in the stairhall of "A" deck, and is over 25 ft. in length. Probably the largest single decorative fluorescent fiitting afloat, it incorporates over 178 ft. of gold and white cold cathode tubing, its metal parts are silver bronze, with exterior reflectors finished in off-white; light is emitted through 27 panels of obscured reeded glass. By way of contrast a tungsten fitting is used to light the forward stairhall between "C" and "B" decks. Six feet in length and 4 ft. 6 in. wide, this fitting employs 24 25-watt lamps, set behind etched pattern obscured glass. It provides a fine example of a modern decorative tungsten fitting.

In some of the public rooms a pleasing effect has been obtained by blending the light from cold cathode tubes of various colours with that from tungsten lamps. This is especially true of the lounge on "A" deck, which has as its centrepiece a large rectangular concealed cove, behind which are gold and ivory cold cathode tubes. In addition, the lounge has several large circular tungsten fittings, each incorporating eight 60-watt lamps. The outside rim of these fittings consists of dense white glass, while the metal work is sprayed pink. Standard lamps, of which there are three in the lounge, are in silver-bronze, finished off-white and fitted with the four-lamp Partridge device, which enables some indirect lighting to be obtained by reflection from the ceiling.

The dining saloon is lighted almost entirely by tungsten, and the lighting effect obtained is in complete harmony with the setting, being complimentary to both diners and foodstuffs. To obtain this effect numerous bowl fittings and ten large circular tungsten fittings, similar to those in the lounge, are employed, together with fittings mounted on the side walls. The latter are in the form of twin candles, surmounted by a natural crinothene shade, and use two 25-watt tubular lamps.

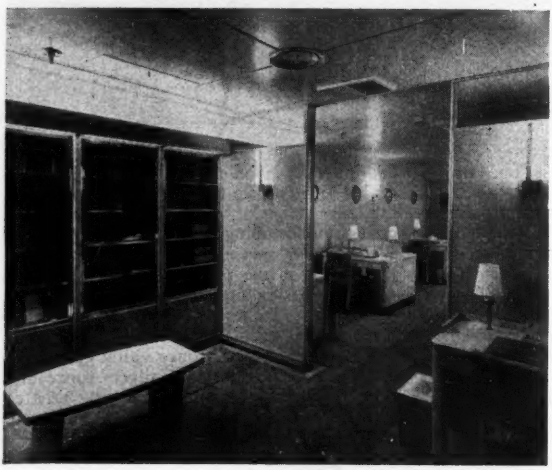


Fig. 7. The library and writing-room on the Ruahine.

Great skill has been employed in the library and writing-room to provide lighting that is at once attractive and restful to the eyes. To light the rows of books cold cathode tubes are concealed in a cornice, with an open glazed bottom, above the bookcase. Attractive wall lights, incorporating twin tubular opal glass lamps set behind tinted peach-coloured obscured glass, are also used; swivel desk lamps are fitted on the writing-tables to provide the reader, or writer, with local lighting. Standard lamps of similar design to those in the lounge complete the lighting in this room.

Bases for Recommended Values of Illumination

This article, the subject of which has aroused much interest, is based on a paper presented at the recent meeting of Commission Internationale de l'Eclairage.

By H. C. Weston

At the Sixth Session of the Commission Internationale de l'Eclairage, Geneva, 1924, a discussion was initiated on standards of lighting from which it was hoped there might emerge international agreement upon the principal requirements. There is, however, still no international agreement as to the basis upon which recommended values of illumination should rest, nor as to what these values should be. To the present writer, it appears that further delay in reaching such agreement cannot be justified on the ground of insufficient knowledge, and can only be prejudicial to the status of the art and science of lighting.

Probably the first recommendation in terms of units of illumination was that made by Cohn in 1883 for the lighting of school class-rooms. His recommendation of 10 meter-candles was arrived at on the basis of experiments, but it was emphatically a minimum hygienic requirement, as have been various subsequent recommended values for different tasks. Nearly three-quarters of a century have since passed and, despite the number of investigations which have been made, chiefly during the second half of this period, formal international agreement upon standards of illumination has not been attained. Yet the problem is not so intractable that it cannot now be resolved if serious and unbiased consideration is given to the material available for the formulation of standards. It is not suggested that this material is exhaustive, but there seems little reason for believing that further investigations—desirable as they may be to augment present knowledge—are likely to invalidate such general standards as can now be formulated, nor that they will enable standards to be laid down with much greater precision.

One outstanding fact should be fully appreciated; it is that human response to given levels of illumination is so variable, as between different individuals and between different times for the same individual, that illumination values for recommendation as generally applicable standards can never be regarded as highly critical, and great argument as to which of two not very different values ought to be recommended for a given purpose will always be idle. This is not to say that definite values should not be stated as recommendations: on the contrary, it is in practice most desirable to avoid the ambiguity of ranges, though it should be understood that, providing the specific values recommended are known to be nearer the probable optimum than to the minimum tolerable, it matters little whether these values are departed from by as much as 30 per cent. in either direction.

Valuable as is the work of Lythgoe and others in establishing the relationship between illumination and visual acuity, it is not possible to take this relation as a basis wherefrom to derive working values of illumination. The measurement of acuity is essentially the measurement of a threshold. Thus, from Lythgoe's work, we learn at what illumination the eye can just resolve detail of given size and good contrast when it is exposed to view for a longer time than is often available in everyday seeing, and which corresponds to a very low visual efficiency. We learn, also, (a) what higher illumination is necessary when acuity is measured by a somewhat more exacting criterion; (b) what kind of "law" connects the growth of visual acuity with that of illumination; and (c) how high is the illumination required for the full realisation of the potential resolving power of the eye. We do not learn what, for most practical purposes, we must know, namely, how much the perception of given detail is facilitated

as illumination is increased above the minimum required for the size involved, i.e., how the recognition time is shortened and the efficiency and ease of the act of seeing is increased. "Efficiency" and "ease" are coupled because the writer believes the latter to be merely the affective aspect of the physiological economies by which any sustainable quickening of the act of recognition must be accomplished. As to this, Hopkinson has found a close correlation of judgments of ease of reading with values of relative performance, i.e., relative speed of reading.

Elsewhere, the writer has shown by how much the illuminations which, according to Lythgoe, give various degrees of acuity must be increased so that simple visual tasks involving detail corresponding in size to these acuities may be done with nearly maximal (90 per cent.) speed and accuracy. The illuminations required for this level of performance were not found to be a constant multiple of the threshold illuminations; the multiple, though always large, varied with the size.

The effect of supra-threshold values of illumination must be ascertained by investigations employing suitable criteria, the objective one —performance—being the most weighty and unequivocal. It has frequently been objected, notably by Luckiesh, that production in practical tasks is not a reliable indication of the illumination which is most beneficial for the actual visual part of such tasks. But the use of *visual performance*, i.e., the speed and accuracy of performing purely visual tasks or the purely visual part of heterogeneous tasks, as an indicator of adequacy of illumination, is not open to the same objection. Nevertheless, the illumination which is adequate for some specific visual tasks is not necessarily adequate for general welfare; it is not likely to be so when the tasks are such as make only small demands upon visual capacity. But the question of the illumination for general welfare can be dealt with by recommending an overriding minimum value which has no necessary relation to the occupational demands upon vision but is necessary to satisfy the natural desire, if not "the inalienable right," of sighted persons to enjoy reasonable "freedom of vision."

These two criteria—visual performance and visual amenity—are those taken in the British method of determining recommended values of illumination. However, many of the values for specific tasks given in the schedule attached to the current I.E.S. Code are based on other criteria and still await systematic checking on the basis of task analysis for size, contrast and other factors, and they are, accordingly, subject to revision.

These other criteria include those generally relied upon hitherto in all countries in which standards of illumination have been recommended, and it is at least partly on account of their shortcomings that discrepant and unstable recommendations are made—to the perplexity of many people who are invited to implement them. One of these criteria is "current practice" and particularly the practice of "enlightened" users. That this practice is dictated by believed need is certainly true, but the belief of need is often biased by ignorance, by the cost of lighting, by propaganda and by other factors, and it rarely has a scientific basis. Analysis of current practice was the earliest method adopted in Great Britain in the endeavour to ascertain what values of illumination might reasonably be recommended as legal minima, though the imperfection of the method was soon recognised.*

As is well known, a variety of other criteria have been used to a limited extent, as in the work of Luckiesh and his collaborators and of other investigators in America and elsewhere. The average of preferred values when the illumination is made variable at will within wide limits has been used as a criterion of adequacy for reading, and a variant of the "choice" criterion was taken by McDermott in seeking the illumination necessary for clerical work.

The illumination for believed typical examples of visually "rough," "fine" and "very fine" work in factories and other work places has been varied experimentally while holding other working conditions as constant as possible, so as to discover, by measuring output, what illumination enables tasks in these broad categories to be done efficiently. British examples are the investigations of Weston and Taylor in printing, of Adams in tile-making, of Weston and of Howell in weaving. Despite objections to the output criterion, the results of these investigations are of considerable value, and most of them have been available for the past 15 years. But, the making of similar "field" experiments to determine suitable working illuminations for most, or even for the most common, of the multifarious occupational

* Tables of illumination values compiled on this basis have been published from time to time during the past 40 years.

tasks would be impracticable and supererogatory.

Instead, the facts that all objects — as visibles — are compounded of extensity patterned by luminance and colour, that their luminances can be controlled and that the power of the eye to see them depends, *inter alia*, upon their luminances, suggested that relations of the kind already exemplified by the visual acuity v. illumination relation might be found for supra-threshold degrees of "visibility," such that satisfactory levels of illumination could be derived for any task if such characteristics were ascertained as the effective (i.e., apparent) size of the "critical" object-detail and the reflectances of the detail and its surround. Beuttell, whose tentative proposals along these lines led to the present writer's investigations, had in mind that it might prove feasible to recommend working illuminations for different tasks which would satisfy the criterion "equal facility of vision" as for the simplest visual task under the lowest commendable illumination.

The Luckiesh and Moss method of prescribing satisfactory illuminations involves the preliminary experimental determination of levels of illumination which, for different values of the task variables (e.g., size and contrast), give various "visibility levels," and, in operation, it involves metering the visibility of any given task in reputed units of visibility referred to a standard task. Luckiesh and Moss advocate illumination values which are said to place the tasks to which each value is applicable at a common "see-level," that is, to give them "equal visibility."

Now, if there is equal facility of vision for objects which differ, e.g., in size and contrast, or if, in other words, these different objects have equal visibility, the visual tasks in which they are involved should be equally performable. But the writer's investigations have shown clearly that there is no practicable scale of illumination values for tasks involving sizes between the limits 1 and 10 minutes (or even for a smaller range) such that equal performance is obtained. The writer, therefore, proposed that recommended values of illumination should be those which permit, *not* equal performance of differently rated visual tasks, but *equal relative performance* of each task, that is to say, which permit the performance of each task to reach its maximum or a standard percentage thereof.

Crouch has compared the writer's illuminations for sizes 1 to 6 minutes, and for a relative performance of 98 per cent. with the illuminations given by the Luckiesh-Moss visibility meter for these sizes to have "equal visibility" to level 4 on the Luckiesh scale. The two sets of illuminations are not widely different, except for the smallest size, but it must be emphasised that these illuminations cannot really give "equal visibility" since they do not permit equal performance. The results obtained by Ferree and Rand in their study of illumination and speed of vision are —like the present writer's findings—inconsistent with the proposition that objects which differ much in size and contrast can be given equal visibility by differently illuminating them according to such scales as those published by Luckiesh and Eastman. The advantage claimed for the visibility-meter method is that it evaluates the visual difficulty of various tasks without the need for measuring the visual size and the contrast of the task-objects, but the difficulties of metering visibility have been pointed out by Dunbar.

To specify illumination values for various task-objects to have some supra-threshold visibility amounts to specifying illumination values which will permit some supra-minimum performance of the tasks. For, if an object is made more than only just visible this can only mean that it has been made more certainly and/or more quickly recognisable. But, unless the visual performance equivalents of different levels on any arbitrary visibility scale are known, the merit of any particular level cannot readily be understood: and if the performance equivalents are known it does not appear that any useful purpose is served by disguising them.

If they are to find ready acceptance in practice, the levels of illumination recommended for occupational use must be referred to a definite utilitarian objective criterion, and this, it is suggested, should be *visual performance*, defined as the speed and accuracy of doing a visual task. For each visual task, according to the size and contrast of its objects, the illumination recommended should, ideally, be what is necessary for maximum performance of that task. But this illumination cannot be ascertained so precisely as can the illumination at which performance reaches some lower value, say 90 per cent. of the maximum, and even this illumination is very high when size is very small and contrast is poor. It is proposed that a scale of illumination values as determined for this standard of relative visual performance, but having as its lower limit a value adequate for reasonable general welfare (of the order of 5 lm./ft.^{2}), might be adopted as the C.I.E. standard scale.

New Lighting Installations

Roller Bearing Works

New bays recently added to one of the five factories of British Timken, Ltd., manufacturers of tapered roller bearings, are lighted by B.T.H. fittings.

The illustration shows an overall view of an Assembly Bay, one of the new parts of the factory, in which 72 dispersive reflectors, each housing a 400-watt mercury vapour fluorescent (MAF/V) lamp with iso-thermal bulb, are used. These fittings incorporate a patent heat baffle, an exclusive feature ensuring safe lamp temperatures. Mounting height is 17 ft., with spacing at 17 ft. 6 in. x 11 ft. 8 in., this arrangement providing an average level of illumination of 20/25 lm./ft.^{2} over a floor area of 14,700 square feet.

A similar layout plan is followed in another new bay in the grinding shops, where 54 of the same type of fittings and

Lighting in the Assembly Shop of one of the British Timken factories.

Showing the newly installed fluorescent fittings in a Bradford bank.

lamps give an identical lighting intensity over the smaller area of 11,025 square feet.

In all sections of this important factory almost 1,500 B.T.H. fittings are now located, and the whole of the electrical installation work has been carried out by Electrical Installations Ltd., of London. Specifications and drawings were prepared by Mr. N. Ramsden, electrical engineer of British Timken Limited, in collaboration with lighting engineers of the British Thomson-Houston Company, Ltd.

Lighting for Banks

The need of good lighting in banks to relieve eye strain and to avoid errors is particularly great because, largely, speed and efficiency of the work is directly related to quick and accurate seeing.

General lighting by large filament lamps in appropriate fittings, together with a multitude of local lights, has only met the needs to a limited extent, and the difficulties of eliminating glare, harsh shadows and deep contrasts of light and shade have been considerable.

Traditional bank interior decoration in this country has not contributed toward visual comforts, and tends to accentuate the drawbacks of high-intensity filament lamp lighting. Banking houses throughout the country are, however, rapidly appreciating the value of fluorescent lighting, which allows reasonably spaced lighting points to provide adequate illumination with very little shadow, comfortable brightness contrasts, good colour rendering, and little or no direct or reflected glare. The fact that good intensity of illumination can also be achieved for very reasonable electricity consumption is also an attractive feature.

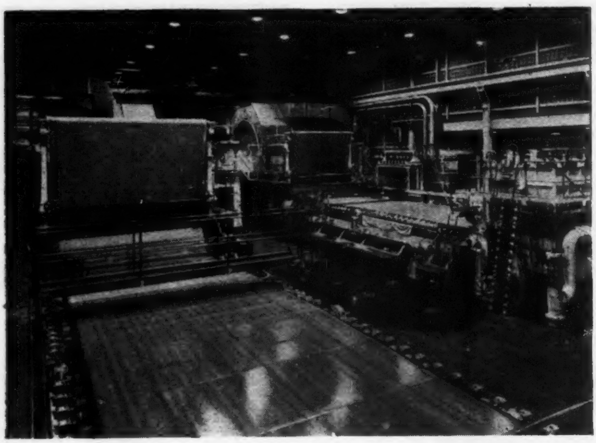
Considerable reduction, and often complete elimination of local lights, helps to clean up the appearance of the interior and at the same time rid the people working at desks under these lights of a source of irritation, distraction, and discomfort.

The photograph above shows the interior of Barclays Bank, Market-street, Bradford, where Crompton "Howard" fittings, each using four 4-ft. 40-watt lamps, are installed. The installation was carried out under the direction of W. J. Morley and Son, architects, of 269, Swan-arcade, Bradford, by Smith and Croft, electrical contractors, 4, Colonnade, Westgate, Bradford.

Lighting a New Paper Mill

Bridgend Paper Mills, Ltd., have recently commenced production in a new mill at Llangynwyd, near Bridgend, Glamorgan. This is considered to be the most up-to-date completed paper mill in this country devoted to the manufacture of bleached and unbleached tissues, serviettes, creping and waxing-base tissues and handkerchief tissues.

A high standard of lighting in daylight hours has been secured by the extensive use of glass brick and ample window space. As the mill works 24 hours a day, special study was given to providing illumination of an equally good standard during the hours of



View of the main machine room in the paper mill showing effect of lighting on the "wires" of the machines.

darkness. There was close co-operation in this matter between the mill executives, the Consulting Engineers (Messrs. J. D. Crozier and Partners, Ltd.) and the Illuminating Engineering Department of the General Electric Co., Ltd.

After visits to works and various discussions, it was decided that the value of illumination over the main working areas at 3 feet above floor level should be of the order of 10 to 12 lm/ft^2. In addition, local or localised lighting should be provided for working or inspection areas where either the general illumination is obstructed, or where higher levels of illumination are required for efficient operation or maintenance.

Suitable schemes employing fluorescent lighting and tungsten lighting were prepared, and after very careful consideration it was decided to employ tungsten filament lamp units for general lighting, and to adopt hot cathode fluorescent units for various positions requiring special or localised lighting. "Osram" lamps and G.E.C. fittings have been used throughout the mill.

The Machine House at present contains three paper-making machines, two large ones having a wire width of 141 in. and a

Lighting of the pulp store with 500-watt lamps in "Saaflux" dispersive units.

finished width of 125 in., and a smaller machine having a wire width of 110 in. and a finished width of 100 in. In passing over the wire—a wire gauze screen—the pulp is drained before entering the Press Section Rolls.

One of the points requiring special attention here was the lighting on the wires, as inspection at this stage is vital both to the quality of the finished product and the avoidance of spoilage. However, due to the reflecting surface it is no easy matter to obtain the right degree of shadow-free illumination without introducing glare. Tests were carried out with 5-ft. 80-watt hot cathode fluorescent angle units mounted on the rails of the walkways, tungsten floodlights mounted at low levels and directed across the wires, and various systems of overhead lighting. It was finally decided that a system of 500-watt high bay units, carefully positioned on each side of the wires and mounted 32 ft. above floor level, would best meet the requirements both of degree of illumination and avoidance of unpleasant reflections.

The first illustration shows the lighting effect obtained by this method on the wires of the two large machines. The average service illumination on the wires is about 20 lm/ft^2, and is obtained by means of three rows of units between the machines in a staggered formation, together with additional units carefully positioned on the wall side.

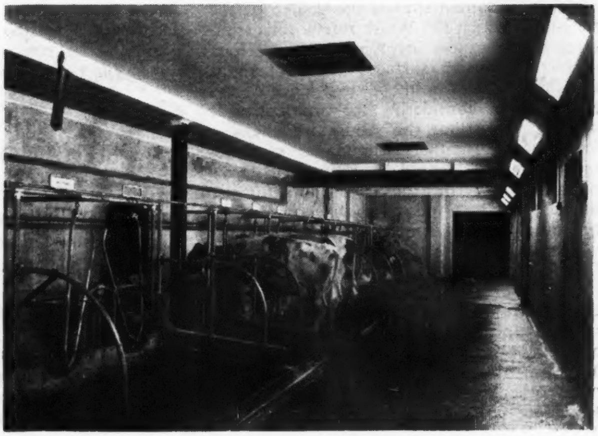
Over the rest of the Machine House the fittings are in two rows between the machines, providing general illumination of the floor and the machines of about 15 lm/ft^2. All the high bay fittings are constructed of anodised aluminium and are fitted with heavy duty "Saaflux" tops. They are, therefore, particularly suited to paper mill conditions.

Angle type units with 5-ft. 80-watt hot cathode fluorescent lamps are arranged over the reeling ends of the machines, and also on the special reelers and slitters; special 5-ft. 80-watt hot cathode units constructed of anodised aluminium are also mounted inside the vapour hood which covers the "dry ends" of the machines, to provide lighting below the hood for inspecting felts, cylinders, etc.

In the Machine Room annexes, where mounting height is restricted, lower wattage "Saaflux" type dispersive reflectors are employed, spaced so as to provide approximately 12 lm/ft^2 in working areas, and approximately 6 lm/ft^2 in remaining areas for general access.

The Morden Stock Preparation Section, where the pulp is refined before passing to the machines, is illuminated by means of high bay units mounted 30 ft. above floor level, and carefully positioned in staggered rows to provide general illumination of the order of 12 lm/ft^2, and also adequate vertical lighting of the control panels mounted on the rear end wall.

Dispersive reflector units with tungsten lamps of various wattages are widely used throughout the mill, and some 200 die-cast bulkhead fittings are installed for local lighting of the underside of machines, etc.



A modern tiled cow byre illuminated by Benjamin type "G" vitreous enamelled Flurolier Reflectors. These fittings are the Angle type each for one 5-ft. fluorescent tubular lamp. The main axis of light distribution is at approximately 35° to the vertical.

Correspondence

Brightness Terms.

To the Editor of LIGHT AND LIGHTING.

Sir,—I am greatly indebted to Dr. J. W. T. Walsh for his confirmation that the literature on Brightness Terms is confusing, and for his guidance on the correct use of the word "Luminosity" employed in my recent article on Brightness Terms. Others have, however, in the past regarded subjective brightness as capable of some measurement (LIGHT AND LIGHTING, *February*, 1943, *p.* 20), and, indeed, I now find that Dr. W. D. Wright in 1943 suggested the use of the word "brills" in connection with degrees of glare. I have not observed this word in use on other occasions and trust he will accept my apologies if I have encroached unwittingly on his preserves. Measurements can be taken with a visual type photometer on, say, a pastel shade of green by an observer who has normal vision, and such are recorded as *Brightness* (*Luminance*) *Measurements.* On another occasion, however, an observer with imperfect colour vision might execute the same test: I should be most grateful for an indication from Dr. Walsh of the correct term for the readings of this observer's sensation if "Luminosity" is not permissible on the score that it cannot be measured.

It is interesting to be reminded that the "Lambert" is a unit accepted in the United States, but that it is not a *metric unit* in spite of the fact that it is based on the metric measure.

An important matter is the dislike of the purists, to which Dr. Walsh refers, for definitions of brightness involving reference to a perfectly diffusing surface: this is perhaps the characteristic point of divergence of the two ways of considering the problem. It would appear that the laboratory engineer feels that all brightness (Luminance) measurements can, and should be, reduced to terms of the Intensity in a particular direction per unit area. The applied lighting engineer, on the other hand, is interested in terms from which he can directly deduce certain other facts. The intensity per unit area method tells him only of a phenomena in the one direction measured, while the perfect diffuser method (provided that it is appropriately applied only to surfaces acting as diffusers) tells him of the properties of the source in many other directions from which he is able to deduce useful facts. The vector diagram for brightness, for instance, of a specular plate reflecting a single light source might be a single line, while the corresponding diagram for a diffusing surface *with just the same brightness in that particular direction* might be a solid such as a hemisphere. Were only the purists' units of Intensity per Unit Area to be allowed there would be no way, from the terms alone, of distinguishing quickly between the capabilities of these two very different sources in distributing their light within an enclosure.

In practice, many surfaces approximate closely enough to the perfect diffuser to form the basis of reasonable and useful calculations, and it is for such reasons that the writer is anxious to keep clearly in mind the nature and functioning of the surfaces with the appearance of which the practical engineer is at any moment concerned.

Reinhardt, writing on Brightness Units (*Illuminating Engineering, Vol. XXXIX, No.* 8) in September, 1944, stated the case for retaining the two conceptions to which I have referred.

I am not irretrievably wedded to the terms I have proposed, and if others more convenient can be suggested they will be welcomed, so long as the important distinction referred to is maintained. Perhaps the retention of "Brightness" for the "candle-power per unit area" conception and some other word such as "Lightness" for the "Lumen per square foot" conception would be considered more acceptable by those of Dr. Walsh's persuasion.—Yours, etc.,

R. R. HOLMES.

London.

SITUATION VACANT

I.E.S. ACTIVITIES

Regional Chairmen—Session 1951-1952

Bath and Bristol.

Mr. R. G. Capell served with the R.F.C. and R.A.F. during the first war and after completing his apprenticeship emigrated to the Southern Hemisphere where he was connected with a number of hydro-electric schemes. For the past ten years he has been with Crompton Parkinson Ltd. He is on the Register of Lighting Engineers.

Birmingham.

Mr. R. A. Lovell joined Crompton Parkinson Ltd., in 1935 and has been their Midlands Area lighting engineer since 1937. He has been an active member of the Birmingham Centre and has been chairman of their General Purposes Sub-Committee for the last two years. He is also on the Register of Lighting Engineers.

Cardiff.

Mr. N. D. Houston is manager of the Cardiff branch of Philips Electrical Ltd. He was for five years Hon. Sec. and Treasurer of the Cardiff Centre and was largely responsible for the inauguration of courses for the City and Guilds exams. at the Cardiff Technical College. He has himself obtained the Intermediate and both Final certificates and is on the I.E.S. Register.

Edinburgh.

Mr. C. K. Ross is principal technical assistant with the City of Edinburgh Lighting Department. He has been with that department for 25 years and was one of the founder members of the Edinburgh Centre. He is on the Register of Lighting Engineers.

Glasgow.

Mr. Alex B. Wright is chief estimating engineer for James Kilpatrick & Son Ltd., of Paisley whom he joined in 1924. He is particularly interested in the contractors'side of illuminating engineering and is one of the few electrical contractors on the I.E.S. Register.

Gloucester and Cheltenham.

Mr. H. E. Phillips has been for over twenty years manager of the electrical contracting department of R. E. & C. Marshall Ltd., of Cheltenham. He is a founder member of the Gloucester and Cheltenham Centre.

Huddersfield.

Mr. E. C. J. Swabey is manager of the lamps and lighting sales depot of the B.T.H. Co. Ltd., in Huddersfield, having been with the company for nearly thirty years. He has been on the Group committee since 1947 and acted as chairman of the Group for the latter part of last session.

Leeds.

Mr. J. Sewell is at present Branch Manager (Supplies Division) Yorkshire Area of Crompton Parkinson, Ltd. He has completed nearly twenty years service with his firm in London, Liverpool and Leeds.

Leicester.

Mr. W. N. Coulson is a founder member of the Leicester Centre and acted as Hon. Treasurer and as Hon. Sec. for a number of years. He is Manager of the Leicester Depot of the B.T.H. Co. Ltd. He is also Vice-President of the Leicester Association of Engineers.

Newcastle.

Mr. W. H. Dodgson is lighting engineer with Metropolitan-Vickers Electrical Co. Ltd., in Newcastle whom he joined in 1936. He has had a wide electrical experience.

Liverpool.

Mr. D. St. C. Barrie, A.M.I.E.E., is District Commercial Officer with the electricity board at Warrington, Lancs. He received his early training with the Portsmouth Electricity Undertaking and went to Lancashire in 1947.

Nottingham.

Mr. C. S. Caunt, F.I.E.S., joined the General Electric Co. Ltd., in 1925 and is now responsible for the lighting department of the Nottingham Branch. He was a founder member of the Nottingham Centre and was for eight years its Hon. Sec.

Manchester.

Mr. James Martin is Manager of the Illuminating Engineering Dept. of Thorn Electrical Industries Ltd., in Manchester whom he joined in 1946. Previously he was for eleven years with Benjamin Electric Ltd. He was chairman of the Leicester Centre in 1944–5.

Sheffield.

Mr. G. L. Tomlinson, A.M.I.E.E., is sub-area Commercial Officer of the No. 3 (Sheffield) sub-area of the Yorkshire Electricity Board. He received his early training with the Blackburn Corporation Electricity Dept. and studied at the Blackburn Technical College and at the Manchester College of Technology.

Forthcoming I.E.S. Meetings

LONDON

October 9th

Sessional Meeting. Presidential Address by J. G. Holmes. (At the Royal Institution, Albemarle Street, W.1.) 6 p.m.

CENTRES AND GROUPS

October 1st

Sheffield

Chairman's Address, by G. L. Tomlinson. (At the Medical Library, The University, Western Bank, Sheffield, 10.) 6.30 p.m.

October 2nd

Stoke-on-Trent

"Lighting of the Houses of Parliament," by R. L. C. Tate. (At 31, Kingsway, Stoke-on-Trent.) 6 p.m.

October 3rd

Cardiff and Swansea

Visit to Works.

Newcastle-on-Tyne

Chairman's Address, by W. H. Dodgson. (At the Minor Durrant Hall, Oxford Street, Newcastle-on-Tyne, 1.) 6.15 p.m.

October 4th

Leicester

"The Lighting of the New House of Commons." (At the Demonstration Theatre, East Midlands Electricity Board, Leicester Sub-Area, Charles Street, Leicester.) 6.30 p.m.

Nottingham

Chairman's Address, by C. S. Caunt. (At the Demonstration Theatre, The East Midlands Electricity Board, Smithy Row, Nottingham.) 5.30 p.m.

Exeter

"Stage Lighting," by J. W. Strange. (At the Providence Hall, Northernhay Street, Exeter.) 7 p.m.

October 5th
Bath & Bristol

" Stage Lighting," by J. W. Strange. (At South Western Electricity Board Lecture Theatre, Colston Avenue, Bristol.) 5.30 p.m. fo 6.15 p.m.

Huddersfield

" Lighting for High Speed Photography and Cinematography," by J. Hadland. (Electricity Showroom, Market Street, Huddersfield.) 7.15 p.m.

October 6th
Leicester

Visit to the new House of Commons.

October 9th
Liverpool

Chairman's Address, by D. St. C. Barrie. (At the Lecture Theatre, of the Merseyside & North Wales Electricity Board's Service Centre, Whitechapel, Liverpool.) 6 p.m.

October 10th
Edinburgh

" Lighting for the Prevention of Industrial Accidents," by E. W. Murray. (At the Welfare Club Hall of the City of Edinburgh Lighting and Cleansing Department, 357, High Street, Edinburgh.) 7.0 p.m.

October 11th
Glasgow

" Lighting for the Prevention of Industrial Accidents," by E. W. Murray. (At the Institution of Engineers and Shipbuilders in Scotland, 39, Elmbank Crescent, Glasgow, C.2.) 6.30 p.m.

Manchester

Annual Luncheon. Presidential Address, by J. G. Holmes. (At the Demonstration Theatre, of the Manchester Town Hall Extension.) 6 p.m.

October 12th
Birmingham

Chairman's Address, by R. A. Lovell. (At the Imperial Hotel, Temple Street, Birmingham.) 6 p.m.

October 7th
Tees-side

" Lighting in the Home,' by Miss M. D. Wardlow. (At the Cleveland Scientific and Technical Institution, Corporation Road, Middlesbrough.) at 6.30 p.m.

October 18th
Gloucester and Cheltenham

Annual Dinner.

October 19th
Huddersfield

" Light, Colour and the Stage," by E. E. Faraday. (At the Large Assembly Hall, Technical College, Queen Street, South, Huddersfield.) 7.15 p.m.

October 22nd
Sheffield

" Radiation, Lighting and Illumination," by J. N. Aldington. (At the Medical Library, The University, Western Bank, Sheffield, 10.) 6.30 p.m.

October 25th
Bradford

" The Application of Modern Flash Discharge Tubes," by C. R. Bicknell. (At the offices of The Yorkshire Electricity Board, Bradford, No. 1 Sub-Area, 45–53, Sunbridge Road, Bradford.) 7.30 p.m.

October 29th
Leeds

" Festival Year in Britain," by T. O. Freeth. (At the Lighting Service Bureau, 24, Aire Street, Leeds, 1.) 7 p.m

POSTSCRIPT

By "Lumeritas"

Pleas for special lighting of the Cenotaph at night have been made by several correspondents—two of them past-presidents of the I.E.S. — writing recently to "The Electrician." The practical difficulties to be overcome if a satisfactory result is to be achieved are not inconsiderable, though they are not insuperable. I have always felt that the Cenotaph should be illuminated permanently, though not, of course, garishly, nor in any manner that would change its appearance adversely. Two of the writers on this subject have suggested that the details of an appropriate practical scheme should be worked out under the aegis of the Illuminating Engineering Society, and I hope something may come of this suggestion.

The time-lag between the propounding of a good idea and its wide application in practice is often depressingly long. I can think of numerous instances of this and, doubtless, so can my readers. And, when eventually an idea does "catch on," often enough it is because someone rediscovers it and puts it forward as new at a propitious time or, at any rate, puts it forward with more gusto than an earlier advocate employed. The idea of painting machinery in light colours is one of those which is not so new as may be thought. Fortunately, the idea is now being carried out extensively, but, in looking through the volume of this journal for the year 1915, I came across a note referring to "a novel method of improving conditions of illumination in factories," to wit, painting machinery white. According to this note, "the practice is being adopted in some factories in the United States of painting all machinery with a white oil-proof enamel. . . . It is said that the light reflected from the machinery is most valuable in eliminating inconvenient shadows and diffusing the illumination. In one case it was found possible to take a photograph in such a workshop in one-seventh of the exposure that would have been required had ordinary unpainted machinery been used."

The Department of Health for Scotland has published (H.M.S.O., Edinburgh) a report entitled "The Reception and Welfare of In-Patients at Hospitals." The committee who prepared the report have this to say about the lighting of wards: "Some wards are very poorly lit at present, and it is difficult for patients to read either in daylight or in artificial light. There are inevitable difficulties, of course, as a result of having more beds in wards than was intended when they were built. So far as possible, however, patients should be in a position where they can read by daylight, and above each bed there should be an artificial light. The latter helps not only the patient but can also be of considerable assistance to the staff when carrying out dressings or examinations. In considering both existing lighting schemes and those which may be provided in the future, hospitals should bear in mind the results of recent researches on lighting technique and standards." It is to be hoped that the concluding sentence will be duly noted by hospital managements both south and north of the Border. The committee also point out that a pleasant colour scheme does much to brighten a dull ward, and, again, their advice to hospitals is that in planning such schemes close attention should be given to the results of modern research and experiment.

The selected design for the new Coventry Cathedral is so unconventional that it has provoked much discussion and some sharply differing expressions of opinion concerning its merits. This is no place to air my views — whatever they may be — either on the aesthetics of the proposed building or upon its becomingness as an ecclesiastical edifice. But the design for lighting is interesting. The stone side walls are to be corrugated or saw-toothed. This construction makes them very strong so that buttresses are not needed, and the columns in the nave, which help to support the roof, can be relatively slender. The designer has placed all the windows in these saw-toothed walls in the short sides of the teeth so that they "look" towards the altar. This ingenious method of securing directional daylighting for a focal area also means that the light sources are placed behind and to one side of each member of the congregation. There should be no direct glare, but in looking down the nave towards the choir the windows will not be visible, and one wonders whether this is not likely to prove undesirable. Artificial lighting is to be "straightforward tungsten," the only departure from this method being discreet floodlighting of the large tapestry which is to hang above the altar.

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